MANAGEMENT AND LEADERSHIP SKILLS AMONG ACADEMIC

RESEARCHERS IN THE VANDERBILT UNIVERSITY

SCHOOL OF ENGINEERING

By

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Thesis

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CHAPTER I

INTRODUCTION

The primary questions this thesis explores are:

- Does managerial training/experience yield more successful managers?

- Has managerial training/experience manifested itself in the form of larger projects being granted to those research managers with such training?

- What techniques do successful project managers employ?

Kathleen Melymuka asserts that project management requires competence in three areas: technology, business, and behavior (Melymuka, 2000). We could assume that the technology component exists in most managers of highly technical projects. The business component we could re-label as "management", particularly when we are concerned with the management of not-for-profit organizations, such as are found in an academic environment. The final component in which the successsful project manager is required to be competent, is behavior. She equates this with "leadership." Therefore, restating her thesis, competent technical project mangers in order to be effective must also possess competencies in both management skills and leadership skills.

Melymuka further asserts that in choosing personnel for positions as project managers, of the three competencies, the most important to focus on is the behavior or leadership component. "People can go to school to learn the technical things, and they can learn the business over time. The behavioral competencies are the ones people are

least able to learn. They're intuitive." Leaders, in her opinion, are therefore, to some

extent, born. The best an organization can do is to identify those with innate leadership

qualities, and develop their technical and management skills.

Volumes have been written about how to manage projects. Milton Rosenau's

1998 book, *Successful Project Management, A Step-by-Step Approach with Practical*

Examples, breaks project management into six parts. Those steps include: define the

goals of the project, plan a project, leading the people who work on a project, monitoring

progress on a project, completing a project, and other issues in project management.

Harold Kerzner's, *Project Management: A Systems Approach to Planning, Scheduling*

and Controlling is one of the many other texts that offer how-to advice on project

management. Most such texts are similar in that they guide the reader cookbook-like

through the phases of project management: concept, planning, execution, and close-

down. It is the countless books like these that add validity to Melymuka's argument that

an organization can train its personnel in the business or management aspect of project

management.

Because of the nature of the university environment, one can reasonably assume

that the technical skills required by project managers already exist in the pool of potential

academic researcher project managers. The final required skill, therefore, is behavioral

or leadership competence. Most authors agree on the nature of the aspects that make up

leadership ability. Some of these aspects include traits like: self awareness, self

management, social awareness, and social skill (Goleman, 2000). There the consensus

falls apart. Many authors claim that leadership skills can be learned. On the other hand,

those like Melymuka contend that leadership is an innate talent. Whether leadership is

learned or innate, most agree it is the third element required for successful technical project management.

This thesis concentrates on the level of management and leadership skills among academic researchers in the Vanderbilt University School of Engineering (VUSE). My involvement with Vanderbilt University's Intelligent Robotics Lab (IRL) provided me with a view of research professors with varying degrees of management experience. Most had no formal managerial training, and little management experience. In spite of the lack of a managerial development program, each was placed in charge of between three and eight graduate student researchers. All three professors impressed me as being committed, enthusiastic, and capable researchers. All three, however, lacked familiarity with management tools which could have made their jobs easier, and thus, increased their probability of success. Each of the professors also had a varying degree of leadership skills.

As a result of my work with the IRL, I have formulated a few basic hypotheses: managers of academic research, who have been trained in management skills, perform better than their counterparts who have no formal managerial training; and managers who exhibit good leadership skills are more likely to lead more successful projects. Finally, I am interested in what managerial tools and practices are used by good research managers.

I, therefore, conducted a limited survey of professors at the Vanderbilt University School of Engineering. The purpose of the survey was to complement my case study of the IRL in order to see how academic R&D leaders have been trained in administrative and managerial skills. I have also surveyed the instructors to determine what

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management practices these managers have employed, and how that may or may not have translated to success in their research projects.

CHAPTER II

OBJECTIVES

Outline

This chapter presents the hypotheses which this paper will explore.

Chapter III covers a review of the literature. In general, there is very little literature on the subject of managing academic research. The bulk of the literature in this review, therefore, focuses on how to manage research groups in general. The literature is broken into three parts. The first part is a study of the special requirements faced by managers of engineers and technical personnel. Following that is a review of guidelines and suggestions for those technical researchers who find themselves thrust into the role of manager. The third part focuses on a review of the leadership skills required by managers of team projects.

Chapter IV outlines the research methodology used in this thesis.

Chapter V discusses the analysis of the research, and presents the findings. This chapter is broken into five parts. The first part discusses the level of management and training experience among various researchers in the Vanderbilt University School of Engineering. The second part is an analysis of some of the management practices employed by those researchers. Next is a discussion of the level of success enjoyed by many of the project managers. The fourth part is an analysis of my hypotheses. The final part of this chapter is a discussion of additional findings.

Chapter VI outlines conclusions as a result of this research.

Hypotheses

The objective of this research is to determine the level of managerial experience and training possessed by those researchers in the Vanderbilt University School of Engineering who have been judged by their peers as being excellent managers of research project teams. Additionally, this research is to determine how academic research leaders have been trained in administrative and managerial skills, and to determine what management practices these managers have employed, and how that may have translated to success in their research projects.

In support of this objective I have formulated five hypotheses.

Hypothesis 1. Better research project managers are likely to have formal managerial training.

Hypothesis 2. Professors with more management training, manage projects with larger budgets.

Hypothesis 3. Better research project managers are likely to have managed multiple research projects in the past.

Hypothesis 4. Professors with more management experience manage projects with larger budgets.

Hypothesis 5. Project Management experience better enables one to manage projects than Project Management education.

CHAPTER III

LITERATURE REVIEW

The Engineer-Manager

Michael Badawy criticizes the engineer-manager. He lauds the unique technical

contributions and abilities of those in the engineering profession in "One More Time:

How to Motivate Your Engineers." Yet he decries the ability of most engineers to

manage and lead in "The Role of the Technical Manager". Though Badawy defines most

engineers and scientist as "generally ill-equipped for a management career," his two

conclusions are not so dissimilar as they might appear at first blush. He attributes much

of the unpreparedness for leadership to engineers switching "to management for the

wrong reasons and to satisfy the wrong needs." Though Badawy's conclusions are based

upon studies of R&D within the corporate world, they are likely applicable to the world

of academia. In both engineering arenas, there is an expectation that as an engineer gains

experience, he will take on the additional responsibilities of working on larger projects,

as well as training and managing younger, less-experienced engineers.

Earlier Badawy wrote of reward systems within organizations that effectively

require engineers to "abandon their profession" and switch to administrative positions in

order to further their careers (1997, 14). This switch for the "wrong reasons" is the root

problem of most engineering mismanagement in Badawy's view. In educational circles,

a similar system is in place, which rewards technical researchers for managing larger and

larger projects. Both prestige and larger budgets entice technical researchers to take on these bigger projects.

"Organizations fail because managers fail" (Badawy 1997, 232) is the logical corollary to the military adage that a leader is responsible for everything that happens or fails to happen within his unit. Badawy then analyzes why managers fail. He breaks down failure into 35 different reasons and assigns each a probability of occurrence from rare to high. Overall he states that the "major cause of managerial failure among engineers and scientists is poor interpersonal skills," or what Goleman calls "social skill" (Badawy, 1997, 234). He claims that engineers as managers fail more often because of "human factors" than because of "technical ability". Surprisingly, the engineers' level of technical ability is another source of managerial failure. He claims that those trained in "hard" sciences are often uncomfortable deciding based upon unquantifiable measurements. Others are "paralyzed" by analysis. They wait for all the data to be in before making a decision rather than going with an 80 percent solution (1997, 235).

Conversely Maidique and Hayes prescribe what they claim must be the attributes of the technologist/leader. The good high technology leader "not only understands how organizations, and in particular engineers, work; they understand the fundamentals of their technology and can interact directly with their people about it" (160). The key elements, therefore are "understanding of organizations" and "interaction with people". These elements are closely akin to the interpersonal and administrative/conceptual skills required of managers according to Badawy (1982, 231). Badawy claims that as managers climb the organizational ladder, the mix of required skills changes by position. At the highest level, administrative and conceptual skills are the largest ingredient of the

required skill recipe. This contrasts sharply with the skills required of first-level managers. Badawy asserts almost no need for administrative and conceptual skills, and a large requirement for technical skills. Administrative skill refers primarily to an understanding of how the organization works. In other words, high-level managers need a firm grasp of the political structure of the company, or in this case, of the university. Conceptual skill means the ability to envision the future for the technological development. Badawy's claim appears logical. We know from experience that successful upper management must possess a vision which they can translate to the organization. We also know that they must possess the political skills to maneuver that vision into reality.

Badawy, Maidique and Hayes all claim generally the same thing: that successful leaders of technology must be that unique individual who possesses both an understanding of the technology itself, and are comfortable with the personal and political structures through which the leader must negotiate.

The "Accidental" Manager

Pinto and Kharbanda provide a tutorial for the technical professional who suddenly and surprisingly finds himself in the role of a project manager. They provide "twelve points to remember" for the "accidental" manager (Pinto and Kharbanda, 1995). Below are listed each of the twelve points and a brief description.

1. Understand the context of project management. Projects exist outside of the organizational hierarchy. Projects, therefore, pose unique problems for managers who manage other instructors or students who do not necessarily report to the manager.

2. Recognize project team conflict as progress. Conflict in human relations is normal. Project managers must learn how to deal appropriately with conflict.

3. Understand who the stakeholders are and what they want. Project managers report to many "bosses." Understanding who they are, what they want, and balancing demands improves the probability of project success.

4. Accept and use the political nature of organizations. All organizations have a "political" element. Project managers must understand the politics inherent in their office, and work within them in order to manage a successful project.

5. Lead from the front. The project manager's role is to be visible as the focal point for the team.

6. Understand what "success" means. The project must be focused on the "triple constraints" of budget, time, and performance. These constraints define success for the particular project.

7. Build and maintain a cohesive team. Managers must play a variety of roles--coach, cheerleader, peacemaker--in order to develop and maintain an effective team.

8. Enthusiasm and despair are both infectious. Teams follow the lead of their leader. The attitudes displayed by the team's leader will permeate the rest of the team.

9. One look forward is worth two looks back. Project managers must plan for the contingencies which will occur, and which, without prior thought, will delay project completion and increase project cost.

10. Remember what you are trying to do. Project managers must step back from a "fire-fighting" mentality, and instead focus on the goals of the project. Too often managers get lost in the minutiae.

11. Use time carefully or it will use you. Efficient time management is key to managerial success at any level.

12. Above all, plan, plan, plan. The planning stage is usually the most important phase to any project.

Most of the points developed by Pinto and Kharbanda fall into the arena of management. The only three points which make up part of the leadership element are: recognizing team conflict, leading from the font, and building cohesive teams. The remaining nine managerial points can be learned from books, examples, or experience.

Project Leadership

Daniel Goleman proposes that there are six basic types of leadership styles, as shown below (Goleman, 2000).

1. Coercive. "Do what I tell you."

2. Authoritative. "Come with me."

3. Affiliative. "People come first."

4. Democratic. "What do you think?"

5. Pacesetting. "Do as I do, now."

6. Coaching. "Try this."

Instead of arguing that leaders have their own unique, and unchanging style, Goleman asserts that effective leaders use a variety of leadership depending upon the situation.

CHAPTER IV

RESEARCH METHODOLOGY

Overview

The tool I first used in this research was a review of the literature concerning management of academic research teams. Quickly I found that while there was ample literature and research on the general subject of managing research and development, there was very little previous work done in the specific arena of managing academic research. I, therefore, have had to extrapolate many of the conclusions reached by those who studied general R&D management, and apply that to the academic arena.

Supplementing my theoretical review of past writings on the subject, I also participated as an observer of a current technical research project within the Vanderbilt University School of Engineering. I was associated with the Intelligent Robotics Laboratory (IRL) as it conducted a research project funded by the Defense Advanced Research Projects Agency (DARPA). The project was designed to develop a Mobile Autonomous Robotics System (MARS).

Based upon my literature review, and my observations of the MARS project team I developed several hypotheses. I then interviewed several of the more experienced researchers who had led multiple projects in order to refine my hypotheses. I then tested those hypotheses using a survey of technical researchers in the VUSE.

Finally, I analyzed the results of the survey in order to develop my conclusions.

The Mobile Autonomous Robot Project

The MARS project is an ongoing two-year, DARPA-funded project designed to provide the Department of Defense with a basic prototype of a mobile "intelligent" robot. In VUSE, the project was conducted in the Intelligent Robotics Laboratory (IRL). The IRL is headed by Dr. Kazuhiko Kawamura. The MARS project officially began in August of 1999. Initially, the project was broken down into three subordinate groups. Each group was led by a non-tenured faculty member. Each group of between three and eight graduate students was responsible for the development of a specific set of robot capabilities.

My observations of each of the three groups continued from August 1999 to January 2000. I specifically focused on how the group leaders distributed and assimilated information. Additionally, I tracked project accomplishments against project goals.

Each of the group leaders had little experience in managing research projects. Nor did any of the group leaders have significant management training that might make up for a lack of experience.

Interviews

Following my literature review of the management of research and development, and my involvement with the IRL project teams, I had developed a few preliminary hypotheses. In order to further refine those hypotheses I conducted interviews with four research managers who had extensive managerial experience and/or training.

I interviewed Dr. Kawamura who had managed numerous research project teams in the past, and who also had training in systems engineering. I interviewed Dr. Susumu Kurokawa who, though he had managed only a few projects, had managerial training at both the Masters and Doctoral levels. Dr. Gabor Karsai, had little formal managerial training, but did have significant experience managing a wide variety of software projects. I interviewed him since he came highly recommended by his peers for being a particularly strong manager of successful research projects. Finally, I interviewed Dr. David Dilts, who though he had no experience with managing technical or engineering projects, did have significant training in project management, as well as experience in research survey design.

After my interviews with these four individuals I was able to formulate my research hypotheses, and develop a cohesive research and survey strategy.

Survey

I conducted a web-based survey of 16 academic researchers at the Vanderbilt University School of Engineering. All were judged by their peers to be leaders in their particular field of technical research. Of the sixteen surveys distributed, ten were returned. Nine were returned with complete results. A total of nine researchers evaluated eight different projects (one had evaluated his work with two different projects). This was not a large enough sample to draw definitive statistical conclusions. However, the purpose of the survey was to identify early trends in order to better focus subsequent research as part of a thesis. It was hoped that even a small sample could show some trends starting to develop, which could then be explored in further research studies.

Using Floyd Fowler's *Survey Research Methods* as a guideline I created the surveys. The questions were approved by both Doctors Kawamura and Kurokawa. The survey was then translated into HTML so that they could be posted on a web site. The web site was constructed in three parts. The first part asked primarily background information. The second part asked questions about specific research projects the instructor had recently led. The third part asked the respondent questions about the importance he or she placed on certain management practices. It may first appear to be a bit unwieldy in asking questions specific to the individual respondent in parts 1 and 3, punctuated by questions about a specific project in part 2. However, the reason for doing so, was in the hope that by getting respondents to think about a specific project, they would then cause the instructors to answer the questions in part 3 with that particular project in mind. The validity of this argument appears to be borne out by the fact that the one instructor who logged on to the site two different times to assess two different

projects answered several questions in part 3 differently on his two trips to the web site. The web pages, as they appeared to the survey respondents appear in Appendix A.

From the database where survey results were stored, I was able to analyze the results of various questions in an attempt to identify any developing trends.

Finally, respondents were asked if they would permit me to contact them for follow-up questioning. All but one respondent consented to this request. I contacted those instructors who provided responses outside of what I expected to find in an effort to determine their reasoning.

CHAPTER V

ANALYSIS AND FINDINGS

The Mobile Autonomous Robot Project

The three team leaders working on the Mobile Autonomous Robot (MARS) project were each responsible for between three and eight graduate student researchers. All three team leaders were technically competent in their particular fields. However, none had any previous managerial experience or training. Each approached organizing and managing their teams slightly differently.

Leadership.

The three teams were made up of relatively homogeneous researchers. That is, the areas of research of the team members within a particular team were relatively similar. To broaden the base of knowledge, the team leaders in both team's 1 and 2 provided their teams with journal articles which had a peripheral impact upon their research. Additionally both of these team leaders placed students in contact with researchers outside of VUSE.

Research objectives were clearly understood. At the project level, the project leader assigned each of the three teams particular objectives to be accomplished by a certain date. In all three teams the team leaders broke those objectives into sub-objectives, and assigned completion of those sub-objectives to the student researchers. It was obvious that all the student researchers understood the link between their particular area of research and the final project. Additionally Team 3's leader ensured that his team

understood the vision of the final user product. He took the technical aspects they were working on and continuously translated those technicalities into the context of the end product.

All three team leaders strove to maintain a level of good interpersonal communication skills. All three used primarily the coaching leadership style, with some instances of the democratic leadership style when it seemed appropriate. Given the nature of the academic environment, the coaching leadership style would appear to be the logical choice since the team leader wishes to not only complete a research objective, but also to impart knowledge. At the team leader level the democratic leadership style was generally used during the occasions when there were obstacles. In the case of all three teams, the team leaders were receptive to notification and identification of problems, and recommendations for overcoming the problem. I never observed any of the other four types of leadership styles. Much of this may have been attributable to the personalities of the individual student researchers. None of them appeared to need coercive or authoritative leadership styles to be prodded into their work.

At the project level, the administrative assistant made a particular effort to arrange gatherings for the team members. Such gatherings were met by the team members favorably. Most team members appeared to genuinely appreciate the recognition and gratitude shown by the project leader and his team leaders.

I observed no instances where there was a direct connection between membership in outside professional organizations and this project. At times, all three team leaders used knowledge they acquired from colleagues outside VUSE to complement their project.

Organization.

The entire MARS project had clear reporting channels. With one exception, each student researcher was assigned to a particular team leader. There was one student researcher whose area of research was so broad that it overlapped two teams. This student researcher was not a member of either group, but instead, worked closely with both groups.

There were no written policies at the project or team levels, but the policies which were in force were clearly understood. There were two major policies. One was that the team leaders were required to submit written reports to the project leader at the end of each month. The second policy was that all spending requests were processed through the administrative assistant for approval by the project leader.

Job descriptions were not formalized and written. However, since everyone's research areas were fairly narrowly focused, their job descriptions naturally evolved from their work. When the potential for conflict or overlap occurred, all three team leaders were quick to determine areas of responsibility.

All three groups had regularly scheduled weekly meetings as discussed below.

The project leader had monthly meetings involving usually only himself, the three team leaders, and the administrative assistant.

With eight student researchers, Team 1 was the largest of the three groups. Meetings were scheduled for the same time every week. Most students attended every meeting. However, it was quite common for the team leader to be late or even absent. Usually his tardiness or absence was forewarned via email. In circumstances where the

team leader was unable to meet with the group, the meeting still continued with the remaining group members.

Team 2 included seven student researchers. They likewise had regularly scheduled weekly meetings. However, when the team leader was expected to be significantly late, or was unable to attend, the meeting was generally cancelled. Topics that were to be covered in the meeting were addressed the following week.

Similarly Team 3 opted to cancel weekly meetings when the team leader was unable to attend. Team 3 had only three student researchers. Therefore, most often the missed topics were addressed one-on-one during the week.

Communication.

All three teams used web-based information sharing. Not only were team members able to communicate in this manner with members of their own team, but they could also communicate with members of the other two teams. This provided an excellent avenue for exchanging information.

All three teams used Email to communicate. Team 1 used it most often. During a four-month period the team leader sent 36 messages to the entire team. Of those, nine dealt only with changes to meeting times. Therefore, 27 messages contained substantive information. The leader of Team 2 used email 23 times during the same period. However, of those messages, 12 informed the team of changes to meetings. Therefore, Team 2's leader used email only 11 times to provide the entire team with substantive information. Team 3's leader used email only 18 times during the six-month period. Of those, 16 emails provided the entire team with substantive information. The figure below illustrates the difference in the use of email to contact the entire team. Team 1 has eight

student researchers, while Team 3 has only three subordinate researchers. The greater use of email by the leader of Team 1 could, therefore, be explained by the difference in size of the teams since email is arguably a more convenient means of contacting all members of a larger group. However, Team 2, with seven student researchers, would then be an anomaly if this theory were to hold true. The difference between Team 2 and the other two teams seems to be that the leader of Team 2 rarely used email to distribute information peripheral to their research. In only one case did the team leader send an abstract of similar research to the team members. On the other hand, Team 1's leader used email seven times to distribute information from outside sources, and Team 3's leader used email twice for a similar purpose. The leaders of Teams 1 and 2 also used email to distribute the monthly status reports to all team members--effectively keeping the student researchers apprised of the "larger picture" of the research project. Additionally those two teams also used email to distribute agendas prior to weekly meetings, and to ask follow-up questions after the meetings--two purposes for which Team 2 did not use email.
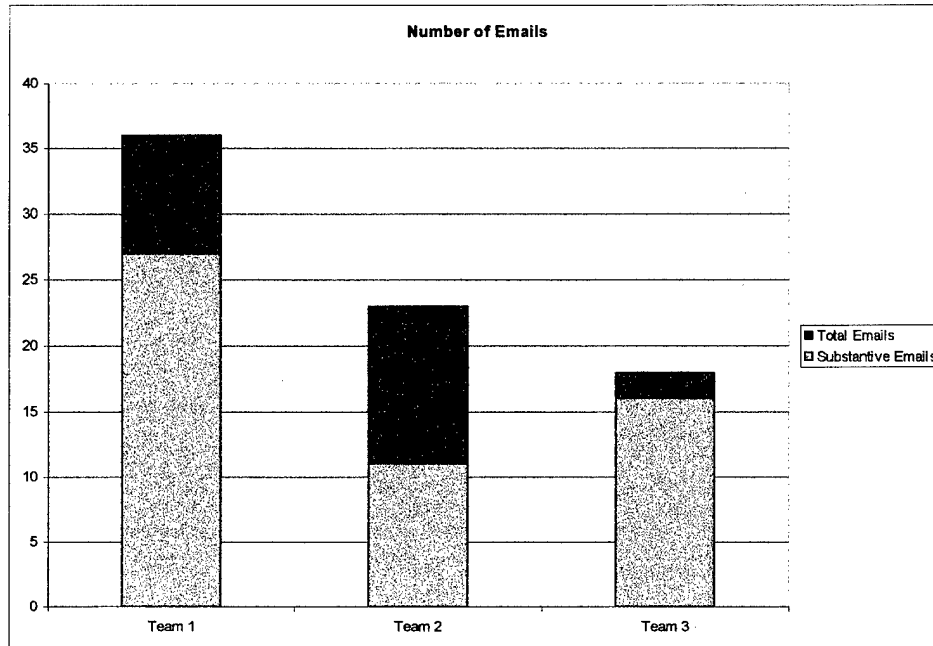
Number of Emails

Figure 1
Number of Emails per MARS Team

All three teams used traditional methods of sharing information. Usually, this was done face-to-face.

Other Issues.

Both Teams 1 and 2 reacted to unforeseeable changes in a similar manner: they evaluated capabilities, and re-assessed interim goals. Visual recognition was a temporary stumbling block for the robotics researchers in Team 1. When it was obvious that a lack of success in this area was delaying other goals, Team 1 decided to change the criteria for success, so that they could continue further research--albeit with some limitations. However, changes in team goals were often not communicated to the project leader and the other teams until the end of month reports were completed.

Team 3, on the other hand, reacted to uncontrollable change by attempting to work harder. At one point due to graduation and student moves, Team 3 dropped in size

to just the team leader and one graduate researcher. In spite of this change in resources, the team decided to attempt to meet the same goals as they had for a team of four personnel. It was only when the issue found the attention of the MARS project leader that the team's goals were restructured to accommodate the change in resources.

Cross-talk between teams was rather spotty. Team 3 was located in a different building across campus, and therefore, face-to-face contact was somewhat limited. Teams 1 and 2 were located in adjacent rooms. Cross-talk between these two groups was much more frequent. To account for this difference in locations, the project leader organized the teams such that the goals for Teams 1 and 2 were more interdependent. Monthly team leader meetings and monthly status reports effectively served to ensure adequate cross-talk was available.

Additionally, there was one graduate researcher who conducted research into an area which was instrumental to the success for both Teams 1 and 2. This graduate student, though not a *de facto* member of either group, attended meetings for both groups. This graduate researcher was a very well-informed source of information for both groups, who served greatly to facilitate cross-talk.

Interviews

Dr. Kawamura, the MARS project leader, stressed the differences between managing corporate research and managing academic research (2000). The two areas where he found there to be the greatest difference was in the emphasis upon timeliness and in the differences in reward and punishment systems. It was his contention that due to a lack of competition and focus upon profit in an academic atmosphere, it was difficult to emphasize timeliness as much as was possible in the corporate environment. Additionally, in a for-profit organization, the research manager had more reward and punishment options available to him. By contrast, in a university the primary student rewards and punishments available are degrees, grants, and fellowships. It was Dr. Kawamura's assertion that the relatively limited number or tools available to the manager, and the diminished focus on timeliness, combine to make the academic research manager's job more difficult.

Dr. Karsai, a software engineering professor in the School of Engineering stressed that "Everybody must be a little bit of a systems engineer these days (1999)." When I interviewed him he was managing two separate projects. Perhaps due to his emphasis upon a broader focus, he employed some research management procedures that did not appear to be often used in academic projects. He contracted with two separate organizations for portions of the project research. One organization was another university, the other was a major corporation. In both cases, the individuals working on his project worked more than 1,000 miles away from Vanderbilt University. As a result of this geographical separation, Dr. Karsai was a strong believer in web-based data sharing, and weekly meetings. Dr. Karsai did not necessarily believe that the project

team itself needed to be made up of a diverse group of researchers. However, he did believe that the project manager should have a broad focus. For one of his projects that had eleven researchers, only one had expertise outside the software engineering arena, while Dr. Karsai played the role of a systems engineer. Left unsaid is how the researcher with a specialized interest, transforms himself into the research manager, who in Dr. Karsai's view, must be a generalist

Dr. Kurokawa advocated training and/or education in management sciences to bridge the gap between the research specialist, and the generalist required to manage research projects (2000). He suggested that a research manager who had such training would tend to be more successful than other research managers who had similar qualifications but lacked a management science background. In effect, Dr. Kurokawa surmised that training and education could make up for a lack of experience. Using Dr. Kurokawa's assertions as a basic outline, I constructed a survey to test the hypotheses.

Dr. Dilts suggested criteria for measuring the success of an academic research project (2000). He also suggested a research survey structure to ferret out how successful particular research projects were. Upon Dr. Dilts' recommendation, I used Floyd Fowler's *Survey Research Methods* to design the final questions for the survey.

Survey Results--Management Training and Experience

No instructors had any experience with management certifications. Three instructors did have management seminar experience experience. Six instructors had experience with projects in or with government organizations. All but three instructors had experience with managing projects in or with industry. The level of experience managing academic research projects at the PI and Co-PI level varied from 0 to more than 24 different projects.

The three instructors with experience attending formal management seminars were also among the instructors with the least amount of academic research experience.
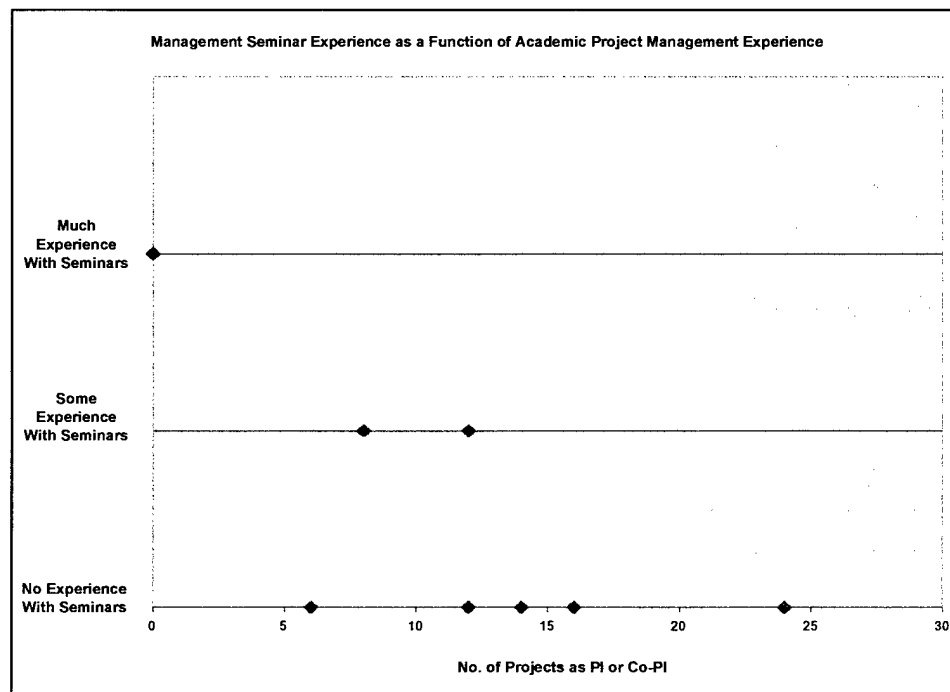

Figure 2
Management Seminar Experience as a Function of Academic Project Management Experience

This suggests several possible conclusions:

- Newer academic researchers are required to take formal management

    training, whereas veteran researchers were never required to do so

- In order to make up for a perceived lack of experience, new instructors

    become certified in management skills so that they can get more lucrative

    research projects

Research project managers with more experience appeared to be more likely to

manage projects with larger budgets as shown below.

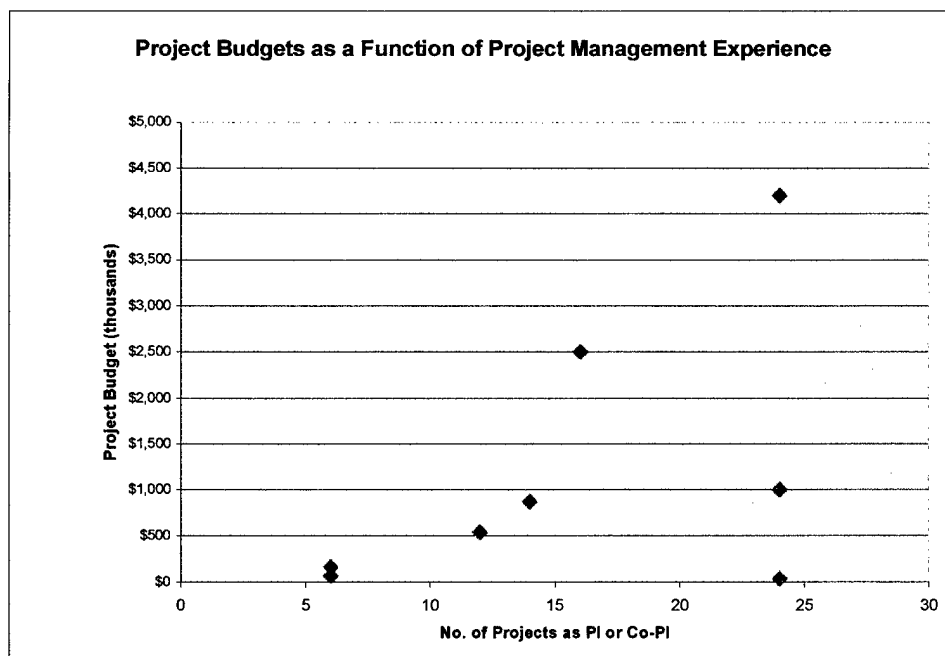**Project Budgets as a Function of Project Management Experience**

Figure 3
Project Budgets as a Function of Project Management Experience

This was not unexpected, as it would appear logical for the more experienced

project managers to be trusted with the larger projects. However, when we combine the

previous two results, we discover that there is no correlation between management

training (measured by seminars and certifications) and larger budgets. In fact, it appears that the size of a project's budget is almost largely related to the experience level of the research project manager.

Survey Results--Management Practices

Respondents were asked to rate how important the following 14 areas are to the success of a research project. There were five choices of answers: "absolutely essential," "usually necessary," "not necessary, but could be helpful," "unnecessary," and "destructive."

Variety of Experiences. Belief in the importance of the project team being made of members with a variety of experiences, were relatively similar. Four instructors said that it was "usually necessary" for project teams to have members with a variety of experiences. Two other respondents said that it was "absolutely essential" and two said it was "not necessary, but could be helpful".

Clarity. All but two instructors agreed that clearly understood research objectives were "absolutely essential." The remaining two said that clarity of research objectives was "usually necessary"

Interpersonal Communication Skills. All instructors agreed that project managers with good interpersonal skills were "absolutely essential" or "usually necessary".

Outside Professional Organizations. Opinion on the importance of team member involvement in outside professional organizations was split. Two agreed that it was "usually necessary," four thought it was "not necessary, but could be helpful," and one believed it was "unnecessary."

Project Team Social Events. Opinion on the necessity of gatherings or excursions for project team members was split. One voted for "unnecessary," five for "not necessary, but could be helpful," one for "usually necessary," and one for "absolutely essential." The three instructors who had managed the largest project (in terms of budget,

and in terms of size of staff) were the three who thought that such gatherings were "not

necessary" or "unnecessary". In fact, as shown below, there is a high degree of

correlation between the project manager's belief in the importance of social gatherings for
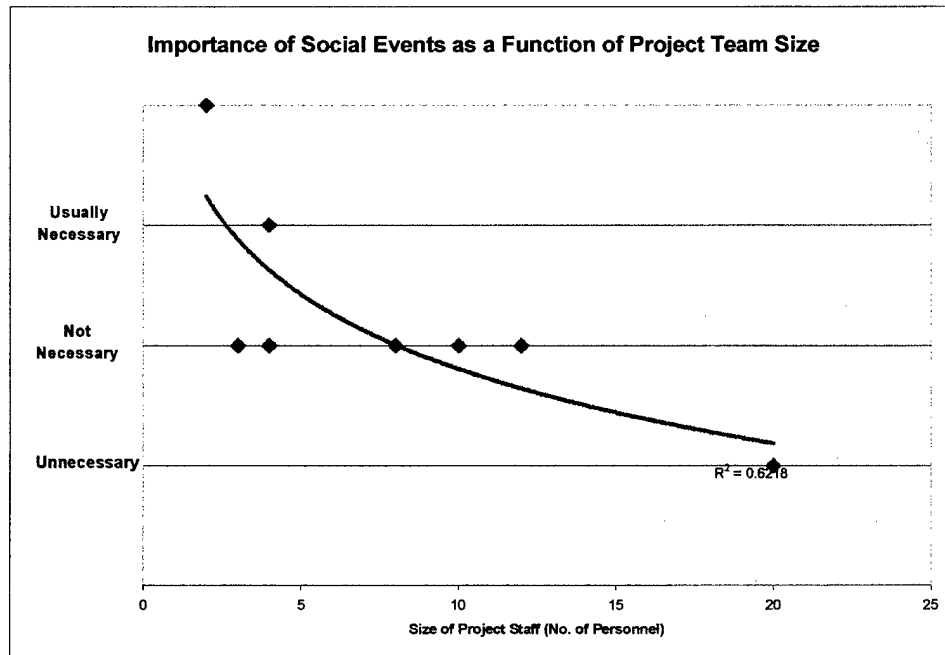
the project team, and the size of the team.

Importance of Social Events as a Function of Project Team Size

Usually Necessary		
Not Necessary		
Unnecessary		$R^2 = 0.6218$

Size of Project Staff (No. of Personnel)

Figure 4

Importance of Social Events as a Function of Project Team Size

A possible hypothesis for this result is that perhaps the smaller teams are by their

very nature more communal, thus naturally resulting in a greater probability of after work

gatherings.

Hierarchy. The belief that clear reporting channels are essential to project

success was generally glustered about "usually necessary." There were two dissenters.

One that that clear reporting channels were "absolutely essential", and the other thought

that they were "not necessary, but could be helpful."

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Written Policies. The importance these instructors gave to written team and project policies was varied. That is, four respondents agreed that formal written team policies were "not necessary, but could be helpful." Three instructors were of the opinion that they were "usually necessary", and the remaining respondent opined that written policies were "absolutely necessary."

Written Job Descriptions. One instructor believed that written job descriptions were "unnecessary;" the remaining believed that codified job descriptions were "not necessary, but could be helpful".

Weekly Meetings. There was great variety of opinion on the importance placed on weekly meetings. Two instructors believed weekly meetings were "unnecessary," two believed weekly meetings were "not necessary, but could be helpful;" two believed weekly meetings were "usually necessary," and two instructors believed weekly meetings were "absolutely essential." The relative importance various instructors placed on weekly meetings was indirectly proportional to the size (in terms of number of personnel) of the project team.
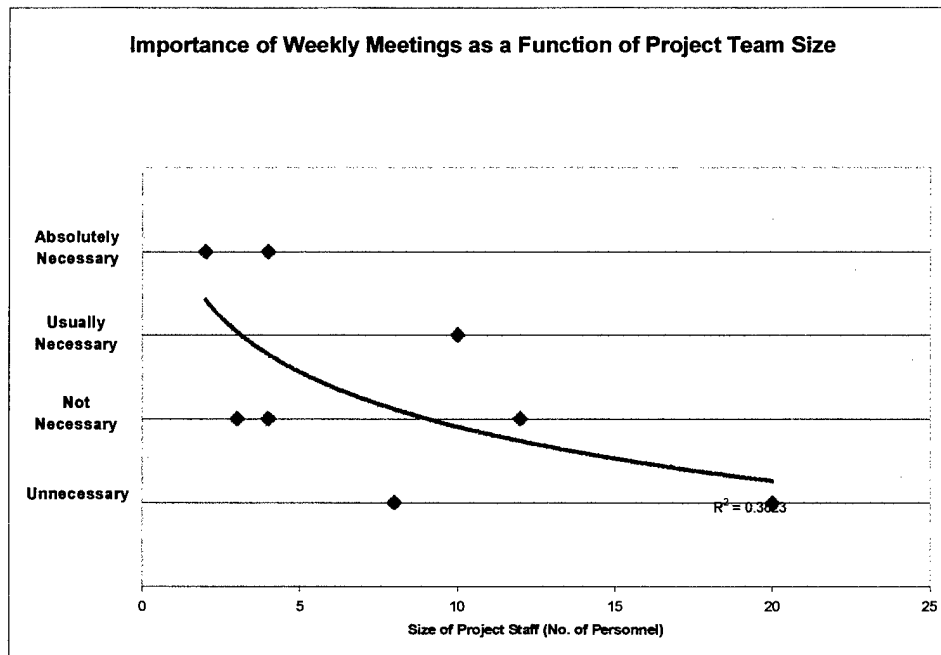
Importance of Weekly Meetings as a Function of Project Team Size

Figure 5
Importance of Weekly Meetings as a Function of Project Team Size

A possible explanation for this correlation is that the larger a project team, the more likely meetings are to be unwieldy, and thus unproductive. With teams of 4 or less personnel, weekly meetings could serve to facilitate discussion, learning, and work. However, meetings involving more people could devolve into a less productive forum for work to be accomplished.

A trend which did not emerge was the relationship between the experience level of the project manager, and his attitude about the importance of weekly meetings. Experienced project managers were not more or less likely to believe in the importance of weekly meetings. The below Figure shows a respondent's attitude about weekly meetings versus his experience managing projects. Experience is measured as the sum of the number of project's he has led at the PI and Co-PI level.
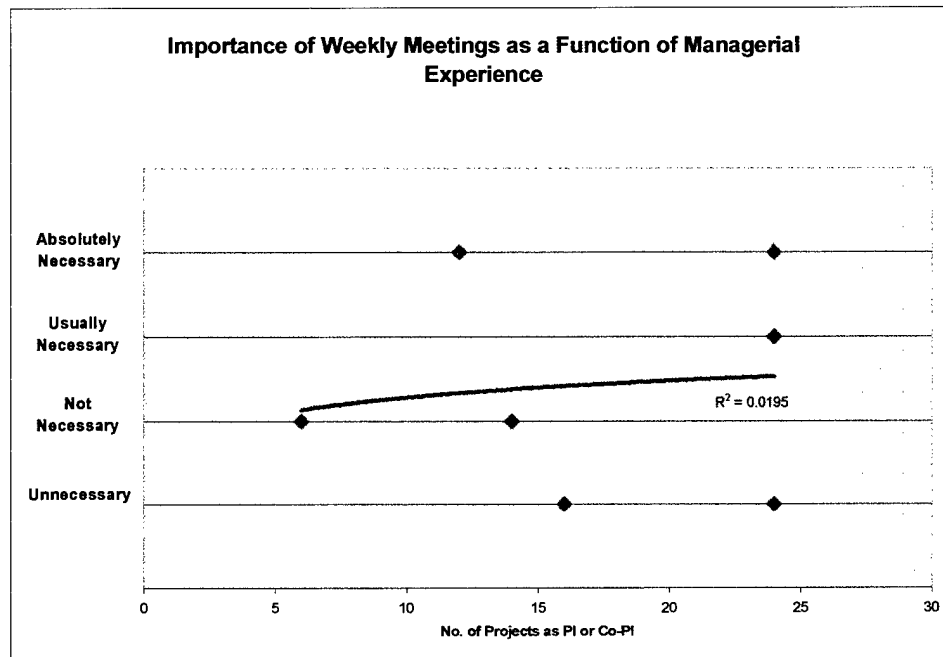
33

Figure 6
Importance of Weekly Meetings as a Function of Project Manager Experience

This result does not, therefore, support the contention that:

- As researchers gain more experience managing projects, they discover that they can conduct the research more efficiently, thus requiring less frequent meetings.

- As researchers gain more experience, they incur more responsibilities. They, therefore, have less time to devote to routine meetings.

This was a somewhat unexpected result.

Monthly Meetings. There was a great variety of opinion on this subject (though not as pronounced as on the subject of weekly meetings). Most instructors believed that monthly meetings were "not necessary, but could be helpful." One instructor was of the belief that they were "unnecessary," two believed they were "usually necessary," and one instructor believed they were "absolutely essential." One of the two instructors who

thought that weekly meetings were "unnecessary," upgraded his opinion of monthly meetings to "not necessary, but helpful." The comparison between the two questions led me to believe that monthly meetings were more often thought to be more appropriate than weekly meetings.

Web-Based Information Sharing. The managers of two of the largest projects gave the least amount of importance to the concept of web-based information sharing. This was the opposite of what I had expected. I expected to find that groupware or web-based information systems for project teams would be more readily used by those managing larger projects.

Importance of Web-Based Information Sharing Systems as a Function of Project Team Size

Absolutely Necessary	
Usually Necessary	
Not Necessary	
Unnecessary	

$R^2 = 0.0514$

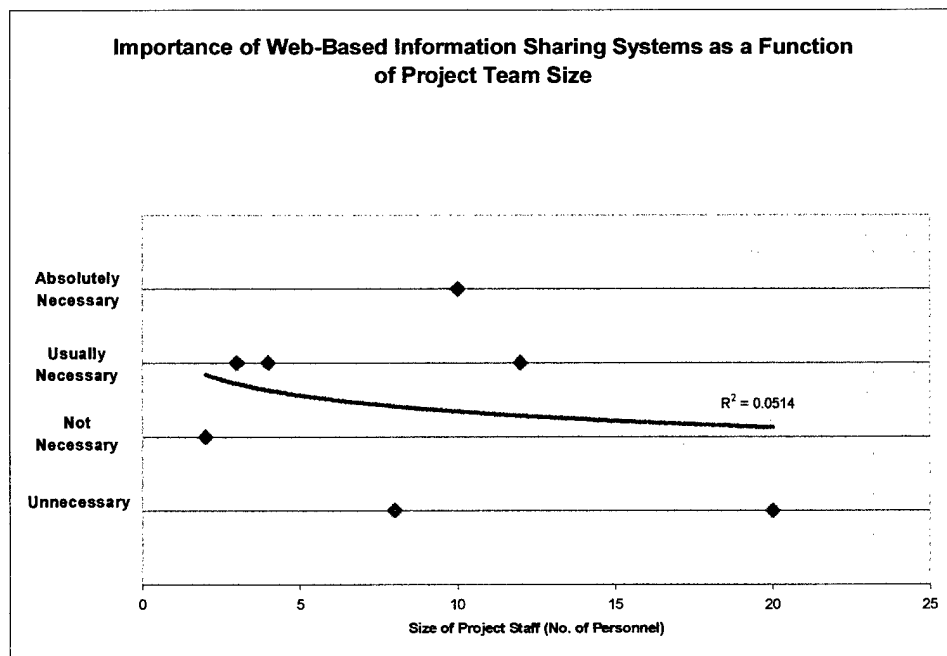Size of Project Staff (No. of Personnel)

Figure 7
Importance of Web-Based Information Sharing Systems
as a Function of Project Team Size

Email Data Sharing. All respondents agreed that email-based information sharing was "usually necessary".

Traditional Information Sharing. All but one respondent agreed that traditional information sharing (fax, phone, etc.) was "usually necessary" or "absolutely essential." The remaining respondent believed that traditional information sharing was "not necessary, but could be helpful."

Face-to-Face Information Sharing. All but two respondent said that face-to-face information sharing is "usually necessary". The lone dissenters said that it was "absolutely essential.

Survey Results--Project Success

Each instructor was asked to rate the success of one or more projects they had recently completed. Success was measured as a function of objectives, budget, and time.

Objectives. The question, "Did the project meet all the customer objectives?" resulted in responses that varied equally between "met most objectives", "met some objectives", and "met all objectives". There appeared to be no identifiable trend between the success of a project and the project's size, budget, source of funding, or managerial training. However, there was a slight trend possibly indicating that project success was a function of experience. This was a result I expected to see.
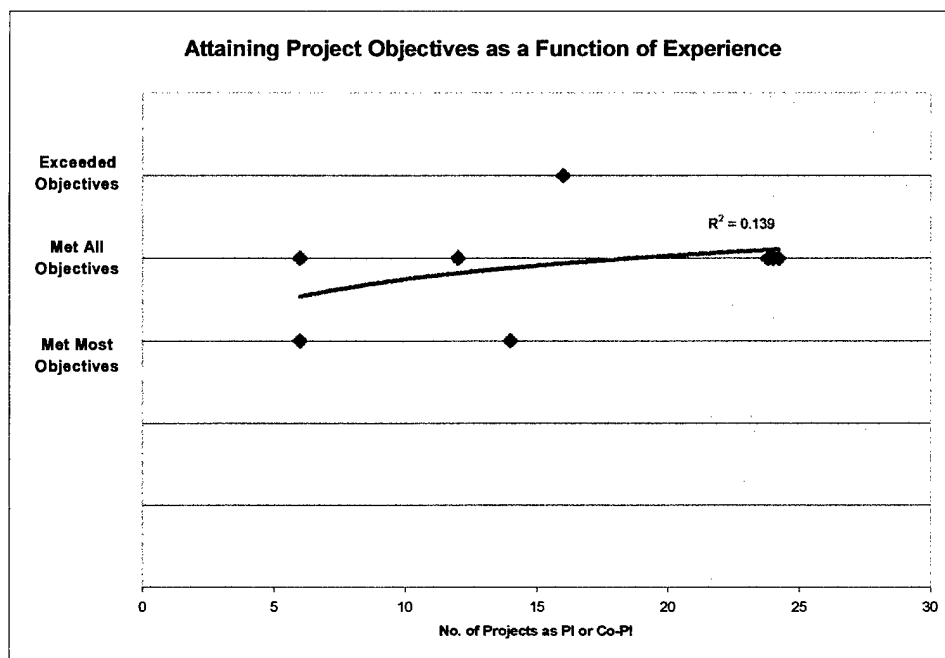
Attaining Project Objectives as a Function of Experience

Exceeded Objectives	
Met All Objectives	$R^2 = 0.139$
Met Most Objectives	

No. of Projects as PI or Co-PI

Figure 8
Attaining Project Objectives as a Function of Experience

Time. In response to the question, "Was the project completed on time?" four projects were judged by their project managers to have been on time, two were completed

late, and one was completed early. There did not appear to be any correlation between experience or training and this result.
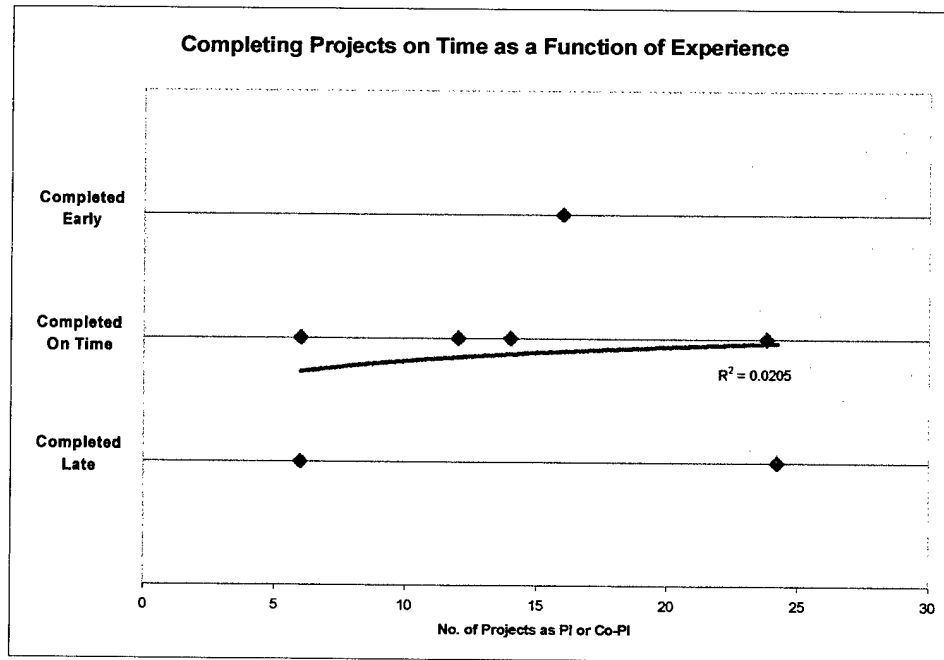

Figure 9
Completing Projects on Time as a Function of Experience

Budget. All projects were judged by the respondents to have been completed within the original budget constraints.

Analysis of Hypotheses

This survey was not large enough, on its own, to conclusively prove or disprove any hypothesis. It does, however, point out some early trends that may be indicative of future conclusions. Beginning with the hypotheses:

Hypothesis 1. Better research project managers are likely to have formal managerial training. This survey indicated that few of the better research project managers had any formal managerial training. In fact, one instructor replied that he had found many of those with formal training to be more of a "hindrance."

Hypothesis 2. Professors with more management training manage projects with larger budgets. The results of this survey do not indicate this to be true. Those in this survey who had formal management training were not the ones with experience. Those, therefore, with management training were not the ones who had managed projects with larger budgets. In spite of the fact that all the survey respondents were judged by their peers to be among the best research managers, perhaps this indicates that for a customer to trust a manager with a larger project, the customer wants to see more experience, and not necessarily more training. This also is an area for further research.

Hypothesis 3. Better research project managers are likely to have managed multiple research projects in the past. The results of this survey indicate that their may indeed be a relationship. Six of the eight respondents indicated that they had been the PI or Co-PI for ten or more academic research projects.

Hypothesis 4. Professors with more management experience manage projects with larger budgets. The results of this small survey clearly seem to point in this direction. A larger sample size should be able to confirm this hypothesis.

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Hypothesis 5. Project Management experience better enables one to manage projects than Project Management education. This survey indicates that experience may be a better teacher than formalized training. Few of these instructors (all of whom were judged to be leaders in research) had any formal training. This begs several questions, however. Could this be a function of the age of the instructors? That is, could it be that older researchers might not have had the opportunity early in their careers to learn in the classroom? Meanwhile, could younger researchers now benefit from formal training, thus allowing them learn before they do? This is a subject for further research.

Additional Findings

As a result of this research I have discovered certain characteristics which were common to most of the "best" research managers. These characteristics include:

- Most had no formal managerial training, nor was any formal or informal managerial training required of a research manager before taking on the task of managing a research project.

- Younger research managers (under 45) had conducted most of their research management experience in a government environment. Almost all of those managers over 45 had research management experience in an industry environment. Only one surveyed manager under age 45 had any previous experience working with industry.

- Most research managers believed that additional managerial training would have no impact, or only marginal impact, upon the success of the management of future research projects.

CHAPTER VI

CONCLUSIONS

The results of this early research seem to indicate that management training has not yet replaced management experience when it comes to leading academic research teams. The relationship between management experience and project budgets, as shown in Figure 3, offers the greatest indictment of the lack of perceived success of management training. This relationship shows a distinct trend developing between a manager's level of experience and the size of budgets granted to him for his projects. This is not an unexpected result. However, if management training is to be able to make up for a lack of management training, we would expect to see that those researchers with management training would be above the curve. This would indicate a researcher with a larger project budget than his experience alone would seem to indicate. At this point in time, however, we do not yet see this trend developing.

Additional early findings resulting from this survey include, and the questions they raise include:

- Are newer researchers being required (or encouraged) to pursue formal managerial training? This could help to explain why none of the researchers with more management experience have had any formalized training.

- Do larger research teams require fewer meetings to be successful?

- Why do managers of larger projects not use web-based information sharing? Is there a more efficient alternative they are using?

- Does more managerial experience allow one to increase the likelihood that a project will be completed on time? Is this an indication of more realistic planning estimates, or a better ability to react to change during the project, or both?

In conclusion, this survey of academic researchers at the Vanderbilt University School of Engineering has in most cases pointed to a confirmation of my hypotheses with respect to experience. That is, it appears that there may be a trend indicating that more experienced managers receive bigger projects, with larger staffs, and are more likely to complete the project to standard, and on time. However, this survey did not find any trends pointing in the direction that management training has been able to make up for a lack of management experience.

APPENDIX A

QUESTIONNAIRE

Welcome,
Would you please take about 10 - 15 minutes of your time to complete an academic survey? I am assisting
a graduate student with his research into the management of technical research projects teams in an
academic environment.
All answers will be strictly confidential.
Sincerely,
Susumu Kurokawa
Research Associate Professor
Management of Technology
Vanderbilt University School of Engineering

Thank you for your help with this survey. I am a graduate student in the Management of Technology
program in the Vanderbilt University School of Engineering. I have spent the last ten years in the Army,
and am pursuing my graduate studies in preparation for a teaching assignment in the Management program
at West Point next year. I am attempting to find the level of management experience that science and
engineering researchers possess, and to discover if there is a linkage between the amount of management
training and the types of research projects.
Thank you very much for your assistance,
Robert T. Krumm
Captain, U.S. Army
Management of Technology
Vanderbilt University School of Engineering
click here to email any questions

0

Background Information.

Last Name [   ]

First Name [   ]

email Address [   ]

Gender | Male ▼ |

Age | ▼ |

Management Training and Experience.
1. Do you have any non-Science degrees?

Yes	MBA

| Yes | M.Ed. |

| Yes | M.S. in a Social Science |

| Yes | B.S./B.A. in a Social Science |

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Yes

Other (Please explain below)

2. Do you have experience with any of the following:
(For each row please check the appropriate column: "No Experience", "Some Experience", or "Much Experience"; depending upon your level of familiarity with the below)

	No Experience	Some Experience	Much Experience
Do you have any Management Certifications?	1	2	3
Have you attended any Management Seminars?	1	2	3
Do you have any Industry Experience?	1	2	3
Do you have any Government Experience?	1	2	3
Other non-Academic Experience (Please specify below)	1	2	3

Please feel free to provide any additional comments below:

3. How many projects have you managed:
(Please scroll down to select the appropriate number)

At the Project Manager or Principal Investigator (PI) level?   None ▼

At the Team Leader or Co-Principal Investigator (Co-PI) level?   None ▼

Submit Part 1

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Part 2 of 3
A Current or Recent Research Project
Thank you for helping with this survey. This page asks about an externally funded team project you have recently managed (within the last five years). You will have the opportunity to provide information about more than one project if you so choose.

| 0 |

What was the Project Name?

What was the length of the project? | less than 6 months ▼ |

What was the total project budget? $

From what organization(s) did you receive funding for this project?

Yes	NSF
Yes	NIH
Yes	DOD (ie. DARPA, etc.)
Yes	Other Government Agency
Yes	Foreign government
Yes	Industry
Yes	Other

How many student researchers and full/part time employees worked on this project?

We would like to ask a few question about this project. Please answer to what extent your project was successful by checking the appropriate item:

	Did not meet objectives	Met some objectives	Met most objectives
Objectives. Did the project meet all customer objectives?	1	2	3
Time. Was the project completed on time?	Project was never completed — 1	Project was completed late — 2	Project w completed time — 3
Budget. Was the project completed within the original budget constraints?	Project was over budget by over 50% — 1	Project was over budget by less than 50% — 2	Project m budget restrictio — 3

Please feel free to provide any additional comments about this project below:

| Submit Part 2 |

Part 3 of 3 This is the last page of this survey.
Management Practices

| 0 |

1. How important do you think the following are to the success of a project:

Leadership	Absolutely Essential	Usually Necessary	Not Necessary, But Could Be Helpful	Unnecessary	Destructive
Variety of experience and education on the research team (ie, previous industry experience, diversity of research backgrounds, etc.)	5	4	3	2	1
Clearly understood research objectives	5	4	3	2	1
Good project manager interpersonal communication skills	5	4	3	2	1
Gatherings/excursions for project team members	5	4	3	2	1
How vital do you think it is for team members to be actively involved in outside professional organizations?	5	4	3	2	1

Organizational	Absolutely Essential	Usually Necessary	Not Necessary, But Could Be Helpful	Unnecessary	Destructive
Clear reporting channels	5	4	3	2	1
Written policies	5	4	3	2	1
Written job descriptions	5	4	3	2	1
Weekly meetings (face to face)	5	4	3	2	1
Monthly meetings (face to face)	5	4	3	2	1

Communication	Absolutely Essential	Usually Necessary	Not Necessary, But Could Be Helpful	Unnecessary	Destructive
Web-based information sharing (team databases or groupware)	5	4	3	2	1
Email data sharing	5	4	3	2	1
Traditional information sharing (telephone, fax, etc.)	5	4	3	2	1
Primarily face-to-face data sharing (ie, hand a team member your work, and explain in person)	5	4	3	2	1

2. How do you rate your level of management training/experience?

| 4 |
I have **sufficient** management training/experience to meet my future needs

| 3 |
I have **significant** management training/experience

| 2 |
I have **little** management training/experience

| 1 |
I have **no** management training/experience

3. To what extent do you think your training/experience in management (or lack thereof) contributed to the success of your projects?

My level of management training/experience has _____

| 6 |
Helped with the success of **most** of my projects

| 5 |
Helped with the success of **a few** of my projects

| 4 |
Been **neutral** with respect to the success of of my projects

| 3 |
Hindered the success of **a few** of my projects

| 2 |
Hindered the success of **most** of my projects

| 1 |
Other |

4. To what extent do you think that additional formal management training (e.g, attending management seminars, etc.) would assist you in managing future projects?
Additional management training/experience would assist with the success of _____

| 5 |
Most of my future projects

| 4 |
A few of my future projects

| 3 |
None of my future projects

| 2 |
Unsure

| 6 |
I require no additional management training/experience

| 1 |
Other |

5. Please feel free to comment on other factors which you feel are important to managing research projects, or comments on this survey:

6. May I contact you for a short follow-up interview? | Yes   Yes | No   No

| Submit Part 3 |

Thank you very much for your assistance.
Sincerely,
Bob Krumm

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